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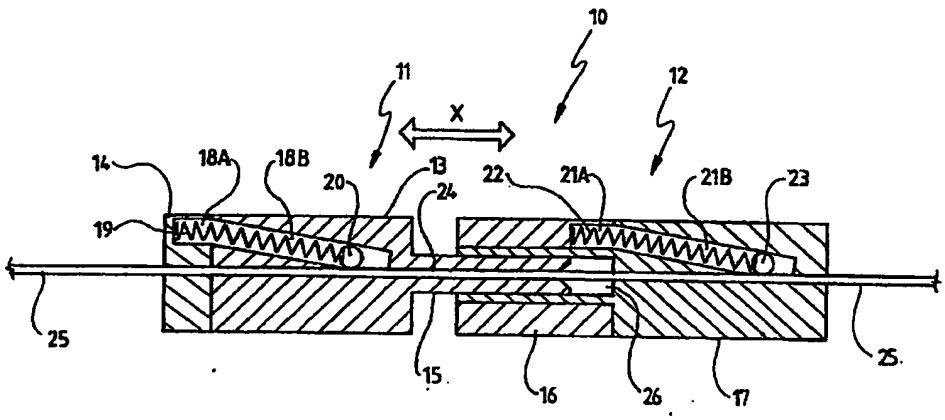
(54) Title: METHOD AND APPARATUS FOR FEEDING WELD WIRE



(57) Abstract: A wire feeding apparatus (10) and method for feeding weld wire to a welder wherein the apparatus includes a first guide (24) along which the wire (25) moves, a second guide (18B) intersecting the first one at an angle of between 5°-20°, a stopper (20) at the intersection for permitting the wire (25) to move along the first guide (24) in one direction only, and a spring (19) for biasing the stopper (20) towards the intersection. A cross sectional size of the first guide (24) is sufficient to allow feeding of wire of different diameters.

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METHOD AND APPARATUS FOR FEEDING WELD WIRE

FIELD OF THE INVENTION

The present invention relates generally to a method and apparatus for feeding wire and particularly weld wire to a welding head and in particular a method and apparatus that can accommodate wire of different diameters.

The invention has been developed primarily for feeding welding wire and will be described hereinafter with reference to this application. However, it will be appreciated that the invention is not limited to this particular use.

BACKGROUND ART

Many welding machines have a wire-feeding mechanism that enables the operator of the welding machine to progressively feed welding wire to a work surface as the welding wire is consumed in the welding process. Such wire-feeding mechanisms typically comprise two opposing rollers between which the wire passes. One of these rollers is a driving roller while the other is a pressure roller. A motor drives the driving roller while the pressure roller presses against the driving roller. Each roller can have a knurled or grooved surface to reduce slippage between the rollers and the wire.

The aforementioned prior art welding wire feeding mechanisms suffer from many disadvantages.

A first disadvantage is that these devices can accommodate wire of a single width only. Thus, if an operator wishes to use wire of a different diameter he needs to either adjust the feeding mechanism or replace it with a different feeding mechanism that is designed to accommodate the new wire.

A second disadvantage is that the prior art wire-feeding mechanisms have the undesirable habit of shaving the wire as it progresses through the rollers. The shavings, if not removed on a regular basis, accumulate and can eventually clog the mechanism.

A third disadvantage is that the rollers of the prior art wire-feeding mechanisms can slip against the wire if the motor is too strong. This

slippage can result in the rollers shaving the wire, which can lead to clogging of the mechanism. If the motor is too weak, the mechanism cannot feed the wire.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a method and apparatus which can substantially overcome, or at least ameliorates, one or more of the deficiencies of the prior art wire-feeding mechanisms.

In one form of the invention, there is provided a method for feeding a weld wire to a weld head, the method comprising contacting the wire with a biased stopper means, the stopper means adapted for reciprocal movement between a wire gripping position where the stopper means grips the wire and pushes the wire along a feed direction and where the stopper means is pushed by the wire against the bias, and a wire sliding position where the wire can slide past the stopper means, and where the wire does not push the stopper means against the bias.

According to a another aspect of the present invention there is provided a regulator device for regulating the direction of movement of an object relative to the regulator device, wherein the regulator device comprises:

a first guide means along which the object moves;

a second guide means substantially intersecting with the first guide means, wherein at an intersection of the first guide means with the second guide means the second guide means is inclined relative to the first guide means , for instance at an angle of between 5° and 20°;

a stopper means substantially located at the intersection;

a biasing means for biasing the stopper means substantially towards the intersection, wherein the stopper means allows the object to move along the first guide means in substantially one direction only.

In a more particular form of the invention, the object comprises a wire passing through the first guide means and the regulator device is coupled to a driver which can selectively move the regulator device relative to the wire.

In an even more particular form of the invention, the driver

comprises a crank arrangement for applying reciprocated motion to the regulator device, wherein the crank arrangement comprises:

a first member that can be selectively rotated;

a second member eccentrically connected to the first member by a ball and socket arrangement;

a third member pivotally connected to the second member; and

at least one linkage member connected to the regulator device and the third member, wherein rotation of the first member causes the second and third members to impart a reciprocating rocking motion to the linkage member.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will now be described by way of example with reference to the drawings in which:

Fig. 1 is a partial cross-sectional view of a regulator device according to a first embodiment of the invention.

Fig. 2A is a side elevation of a wire-feeding mechanism utilising the regulator of Fig. 1 according to a first embodiment of the invention.

Fig. 2B is a front elevation of the wire-feeding mechanism illustrated in Fig. 2A.

Fig. 2C is a partial front elevation of the wire-feeding mechanism illustrated in Figs. 2A and 2B.

Fig. 3 is a right side elevation of a wire-feeding mechanism according to a second embodiment of the invention.

Fig. 4 is a first left side elevation of the wire-feeding mechanism illustrated in Fig. 3

Fig. 5 is a top elevation of the wire-feeding mechanism illustrated in Figs. 3 and 4.

Fig. 6 is a first bottom elevation of the wire-feeding mechanism illustrated in Figs. 3 to 5.

Fig. 7 is a second bottom elevation of the wire-feeding mechanism illustrated in Figs. 3 to 6.

Fig. 8 is a second left side elevation of the wire-feeding mechanism illustrated in Figs. 3 to 7.

Fig. 9 is a first end elevation of the wire-feeding mechanism illustrated in Figs. 3 to 8.

Fig. 10 is a second end elevation of the wire-feeding mechanism illustrated in Figs. 3 to 9.

DETAILED DESCRIPTION

Fig. 1 is a partial cross-sectional view of a regulator device indicated generally by 10. The regulator device 10 forms part of a wire-feeding mechanism.

The regulator device 10 comprises two elements indicated generally by 11 and 12. Element 11 slideably engages with element 12 via a projection 15 which mates with a cavity 26 formed in element 12. Elements 11 and 12 are able to move relative to each other as indicated by X.

A channel 24 passes substantially through the centre of elements 11 and 12. The channel 24 allows a wire 25 to pass through the regulator device 10. The diameter of the channel 24 is dimensioned so as to accommodate the largest diameter wire used. In this particular embodiment, the channel 24 can accommodate a wire having a diameter of between 0.9mm to 1.6mm. It can be appreciated though that the diameter of the channel 24 can be varied to suit.

Element 11 consists of two sub-elements numbered as 13 and 14. Although not visible in Fig. 1, sub-elements 13 and 14 are substantially rectangular prisms while projection 15 is cylindrical. The shape of these aforementioned components is not limited to these shapes. A cavity 18A extends part way through the sub-element 14. The cavity 18A is offset from and substantially parallel to the channel 24. In this embodiment the cavity 18A is cylindrically shaped and can be formed in the sub-element 14 by a drilling process. It can be appreciated though that the shape of cavity 18A can be varied to suit and can be formed by other processes.

A cavity 18B extends part way through the sub-element 13. At a first end of the sub-element 13, the cavity 18B is offset from the channel 24. The cavity 18B is also inclined relative to the channel 24 and substantially intersects with the channel 24. In this embodiment, the angle of inclination of the cavity 18B relative to the channel 24 is 10°. Also, the cavity 18B is

cylindrically shaped and can be formed in the sub-element 13 by a drilling process. It can be appreciated that the angle of inclination and shape of cavity 18B can be varied to suit.

Before sub-elements 13 and 14 are attached together, a ball bearing 20 whose diameter is substantially the same as the diameter of the cavity 18B is inserted into the cavity 18B. Next, a cylindrical spring 19 whose diameter is substantially the same as the diameter of cavity 18B is inserted into the cavity 18B. Sub-element 14 is then attached to sub-element 13 so that cavities 18A and 18B are aligned. The spring 19 is of such a length that a portion of it is contained in cavity 18A. The spring 19 is also subjected to a compressive force. Thus, the spring 19 exerts an outwardly directed force on the ball bearing 20. In this manner, the ball bearing 20 is biased towards the channel 24. Sub-elements 13 and 14 are attached together by a screw (not shown) that passes completely through sub-element 14 and only partially through sub-element 13.

Element 12 consists of two sub-elements numbered as 16 and 17. Sub-element 16 is an annulus while sub-element 17 consists of a first cylindrical portion having a large diameter and a second cylindrical portion having a diameter that is smaller than the first cylindrical portion. In this embodiment, the length of the second cylindrical portion is equal to the length of the cavity 26. Sub-element 16 engages with the second cylindrical portion of sub-element 17 by an interference fit.

A cavity 21A extends part way through the sub-element 16. The cavity 21A is offset from and substantially parallel to the channel 24. In this embodiment the cavity 21A is substantially cylindrically shaped however other shaped cavities could be used.

A cavity 21B extends part way through the sub-element 17. At a first end of the sub-element 17, the cavity 21B is offset from the channel 24. The cavity 21B is also inclined relative to the channel 24 and substantially intersects with the channel 24. In this embodiment, the angle of inclination of the cavity 21B relative to the channel 24 is 10°. Also, the cavity 21B is cylindrically shaped and can be formed in the sub-element 17 by drilling. It can be appreciated that the angle of inclination and shape of cavity 21B can

be varied to suit.

Before sub-elements 16 and 17 are attached together, a ball bearing 23 whose diameter is substantially the same as the diameter of the cavity 21B is inserted into the cavity 21B. Next, a cylindrical spring 22 whose diameter is substantially the same as the diameter of cavity 21B is inserted into the cavity 21B. Sub-element 16 Is then attached to sub-element 17 so that cavities 21A and 21B are aligned. The spring 22 is of such a length that a portion of it is contained in cavity 21A. The spring 22 is also subjected to a compressive force. Thus, the spring 22 exerts an outwardly directed force on the ball bearing 23. In this manner, the ball bearing 23 is biased towards the channel 24.

Elements 11 and 12 of the regulator device 10 form a positive feed mechanism by allowing the wire 25 to be drawn through each of the aforementioned elements in one direction only. For the embodiment shown in Fig. 1, the wire 25 can only be inserted into element 12 followed by element 11. This is because as the wire reaches the ball bearing 23 of element 12, the wire forces the ball bearing to move against the spring 22. Once the ball bearing 23 has moved sufficiently, the wire 25 is free to move along channel 24 in element 12. Due to the force exerted by the spring 22 on the ball bearing 23, the ball bearing 23 presses against a surface of the wire 25, however this force is not sufficient to prevent the wire moving.

If an attempt to reverse the direction of travel of the wire 25 is made, the force exerted by the ball bearing 23 on the wire 25 increases dramatically such that the ball bearing 23 effectively prevents the wire 25 from moving in the reverse direction.

It should be mentioned that the distal end of the projection 15 surrounding the channel 24 is countersunk for easy insertion of the wire 25 into the element 11.

Figs. 2A to 2C illustrate a first embodiment of a wire feeding mechanism indicated generally by 27. The wire feeding mechanism 27 utilises the regulator device 10 illustrated in Fig. 1.

Visible in Fig. 2A is the regulator device 10 as well as a portion of a crank for moving the elements 11 and 12 of the regulator device 10

relative to each other. By moving elements 11 and 12 relative to each other, the crank is able to progressively feed a wire (not shown) through the regulator device 10. Although not shown in Fig. 2A, member 30 of the crank remains in the same position relative to element 12. Thus, if element 12 remains stationary, it is element 11 that is able to move back and forth relative to element 12.

The crank consists of a first member 30 that is rotated by an axle 40 of an electric motor (not shown). A second member 29 is connected to the first member 30 by a ball and socket arrangement. In this embodiment, the ball and socket arrangement consists of a ball portion 37 formed on the second member 29 that is engaged to a socket 38 formed in the first member 30.

As illustrated in Fig. 2C, the socket 38 is eccentrically located on the first member 30.

The second member 29 shown in Fig. 2A is bifurcated at an end opposite to that having the ball portion 37. Located in the bifurcation of the second member 29 is a third member 33 that is connected to the second member 29 by a hinge 36.

Connected to the third member are two L-shaped members 28 of which only one is visible in Fig. 2A. The L-shaped members 28 are connected to the third element by a hinge 34. The distal ends of the L-shaped members 28 are connected to the element 11 by hinges 31.

Fig. 2B is an end elevation of the wire-feeding mechanism 27. Visible in Fig. 2B are both L-shaped members 28. Although not previously mentioned, the hinges 31 are integrally formed on the element 14. In this embodiment, washers 39 are interposed between the element 14 and the L-shaped members 28. Additionally, washers 32 are mounted on the hinges 31. The distal ends of the hinges 31 are threaded (not shown) and can accommodate a nut (not shown).

It can also be seen from Fig. 2B that the second member 29 of the crank has a width that is less than that of the third member 33. This allows the bifurcated end of the second member 29 to pivot about hinge 36 as the first member 30 rotates the ball portion 37 about the electric motor's axle.

As the second member 29 pivots about hinge 36 the rotation of the ball portion 37 causes the second and third members to pivot about the hinge 34 which is fixed in position relative to the element 12 and the first member 30.

The aforementioned pivoting movement causes the L-shaped members 28 to pivot about the hinge in synchronisation with the third member 33. Since element 11 is constrained so as to only be able to move back and forth relative to element 12, the pivotal movement of the L-shaped members impart this motion to element 11.

In order to feed a wire through the regulator device 10, the wire is inserted into the regulator device 10 such that a portion of the wire extends past the ball bearing 23 contained in element 12. Movement of the crank then causes the element 11 to move relative to the element 12 in the manner previously described.

If the element 11 moves away from element 12, this is equivalent to trying to move the wire in the reverse direction relative to element 11. Thus, the ball bearing 20 in the element 11 will prevent the wire from moving relative to element 11. However, the wire is pulled through the element 12 because the direction of movement of the wire relative to the element 12 is in a direction in which the element 12 allows the wire to move.

If the element 11 moves towards element 12, the wire can be moved through the element 11. Thus, element 11 effectively slides over the wire. However, the wire is held in position by the ball bearing 23 in the element 12.

The above-described mechanism corresponds to alternately clamping the wire with element 11 and element 12. Element 11 clamps the wire when element 11 moves away from element 12. When element 11 moves towards element 12, the wire is free to move through element 11 but is clamped by element 12.

It can be appreciated that operation of the above-described wire feeding mechanism results in the movement of wire being substantially discontinuous. Welds formed by moving the wire in this manner tend to be better than welds formed by moving the wire smoothly and continuously. This

may possibly be due to an improved penetration and wetting action.

Various views of a wire-feeding mechanism according to a second embodiment are illustrated in Figs. 3 to 10. In this embodiment, components that are similar to those of the first embodiment are indicated by the same indices.

Fig. 3 is a right side elevation of the wire-feeding mechanism. In this embodiment, a frame consisting of a base 42 and support arms 41A and 41B support the mechanism. A welding wire 25 can be seen to protrude from either end of the mechanism.

Visible in Fig. 3 is element 12, sub-elements 13 and 14 as well as protrusion 15 of the regulator device 10. This embodiment differs from the first embodiment in that element 12 substantially covers sub-elements 16 and 17. A shroud 43 has also been included. The shroud allows the welding wire 25 to be easily inserted into the element 12. Also, members 28 that are substantially straight have replaced the L-shaped members of the first embodiment.

Fig. 4 is a left side elevation of the wire-feeding mechanism. The first member 30 and second member 29 of the crank can be seen in this diagram. Attached to the base 42 and operatively engaged to the first member 30 is a linking member 44 that links the first member 30 to the axle of an electric motor (not shown). Rotation of the linking member 44 causes the first member 30 to rotate.

Fig. 5 is a top elevation of the wire-feeding mechanism. The support arms 41A and 41B and members 28 are clearly visible in this diagram.

Fig. 6 is a bottom elevation of the wire-feeding mechanism. The third member 34 that is attached to the second member 29 by hinge 36 can be seen. Also visible is a part of the ball portion 37 of the second member 29 that is eccentrically connected to the first member 30. The channel 24 can also be seen.

Fig. 7 is another bottom elevation of the wire-feeding mechanism that more clearly shows the different components.

Fig. 8 is another left side elevation of the wire-feeding

mechanism that more clearly shows the different components.

Fig. 9 is an end elevation of the wire-feeding mechanism showing the base 42. The linking member 44 shown in Fig. 4 is coupled to an electric motor by side 45.

Fig. 10 is an elevation of the opposite end of the wire-feeding mechanism. The hinge 36 is clearly visible in this diagram.

The apparatus can be modified to adjust the "stroke length" between elements 11 and 12, thereby adjusting the incremental advance rate of the wire.

The foregoing describes only one embodiment of the present invention and modifications, obvious to those skilled in the art, can be made thereto without departing from the scope of the present invention.

It is to be understood that the term "comprising" as used herein is to be understood in the inclusive sense of "having" or "including" and not in the exclusive sense of "consisting essentially of".

CLAIMS:

1. A wire feeding apparatus for feeding weld wire to a welder, the apparatus comprising:

a first guide means along which the wire moves;

a second guide means substantially intersecting with the first guide means, wherein at an intersection of the first guide means with the second guide means the second guide means is inclined relative to the first guide means at an angle of between 5° and 20°;

a stopper means substantially located at the intersection;

a biasing means for biasing the stopper means substantially towards the intersection, wherein the stopper means allows the wire to move along the first guide means in substantially one direction only.

2. The apparatus of claim 1, including a driver which can selectively move the apparatus relative to the wire.

3. The apparatus of claim 1, comprising two elements adapted for reciprocal movement relative to each other.

4. The apparatus of claim 3, wherein the first guide means is a passageway in each element, the passageways being in linear alignment, the wire being adapted to pass through the passageways.

5. The apparatus of claim 4, wherein the passageways have a cross section size to allow passage of wire of different diameters.

6. The apparatus of claim 5, wherein the stopper means is a ball.

7. The apparatus of claim 6, wherein one said element has the second guide means along which the ball can move, the guide being substantially linear.

8. The apparatus of claim 7, wherein the biasing means comprises a spring in the second guide means and which is positioned behind the ball to bias the ball towards the first guide means.

9. The apparatus of claim 8, wherein the other said element is provided with a said second substantially linear guide means along which the ball can move and wherein the biasing means comprises a spring in the second guide means and which is positioned behind the ball to bias the ball towards the first guide means.

10. The apparatus of claim 9, wherein one said element adopts reciprocal movement and the other said element is fixed.

11. The apparatus of claim 10, comprising a crank arrangement for reciprocating one said element with respect to the other said element, wherein the crank arrangement comprises:

a first member that can be selectively rotated;

a second member eccentrically connected to the first member by a ball and socket arrangement;

a third member pivotally connected to the second member; and

at least one linkage member connected to the regulator device and the third member, wherein rotation of the first member causes the second and third members to impart a reciprocating rocking motion to the linkage member.

12. A method for feeding a weld wire to a weld head, the method comprising contacting the wire with a biased stopper means, the stopper means adapted for reciprocal movement between a wire gripping position where the stopper means grips the wire and pushes the wire along a feed direction and where the stopper means is pushed by the wire against the bias, and a wire sliding position where the wire can slide past the stopper means, and where the wire does not push the stopper means against the bias.

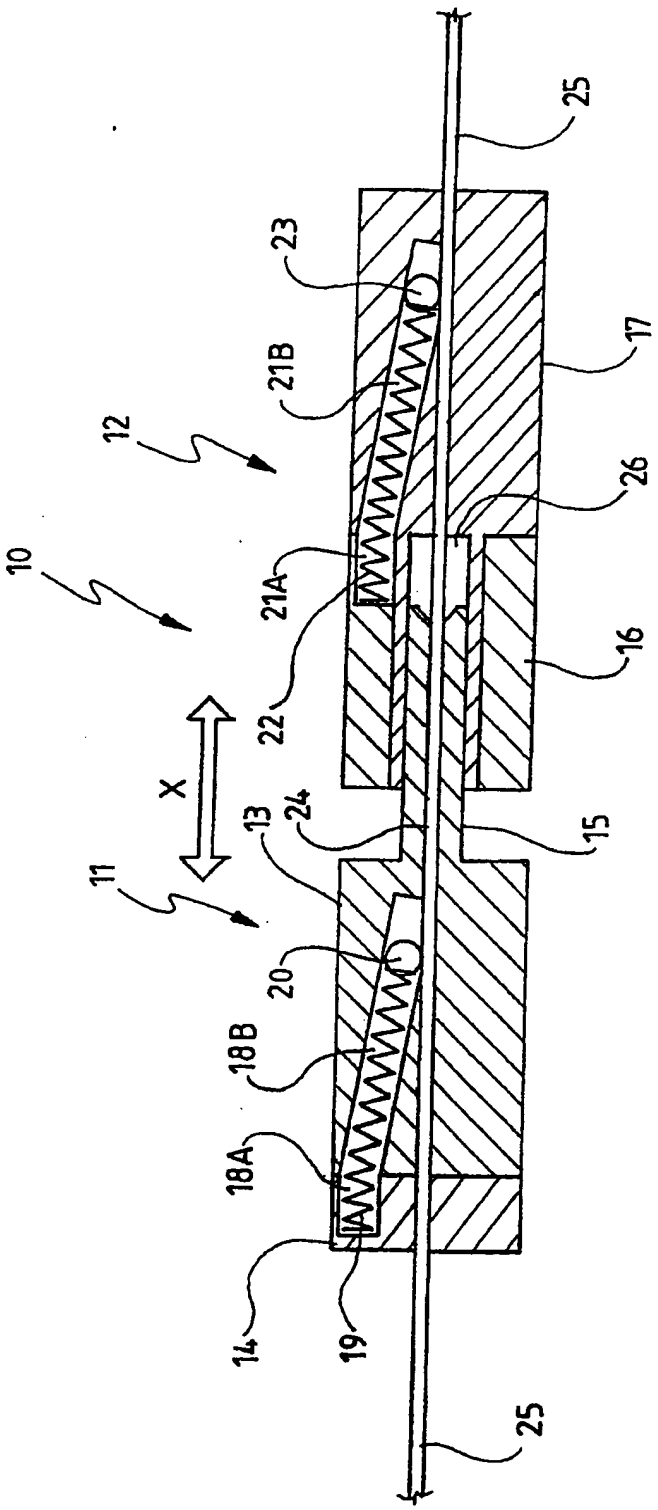

Fig. 1

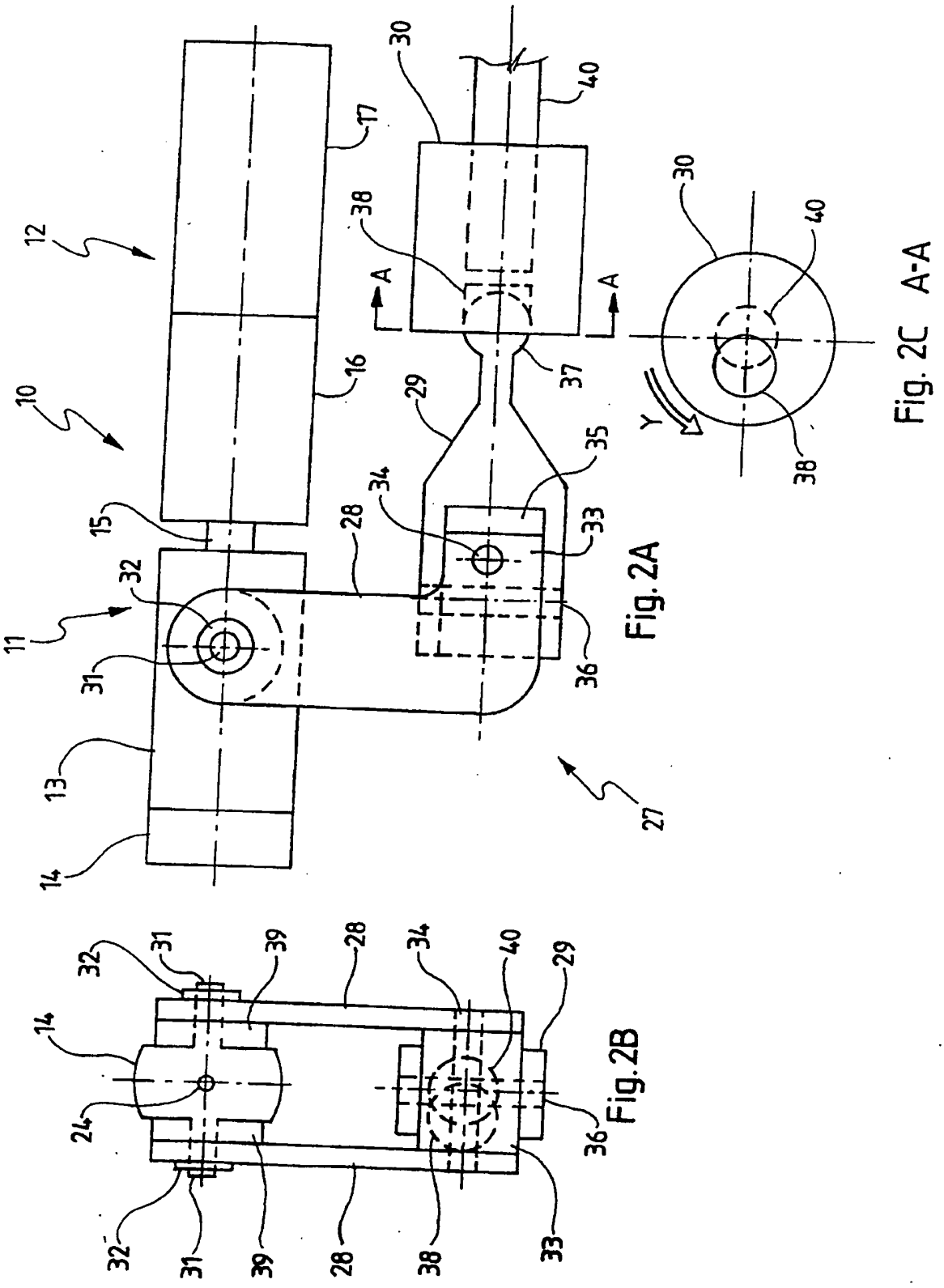

Fig. 2A

Fig. 2C A-A

Fig. 2B

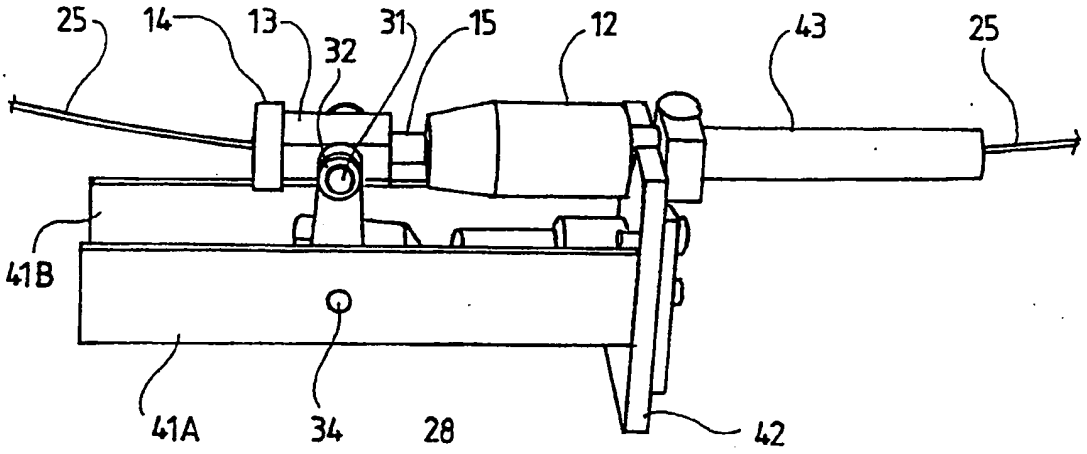

Fig. 3

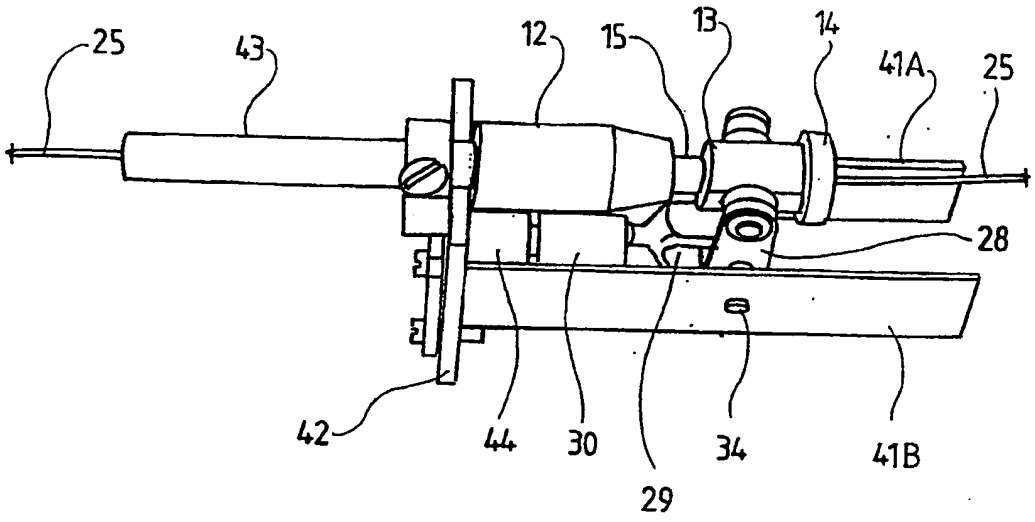

Fig. 4

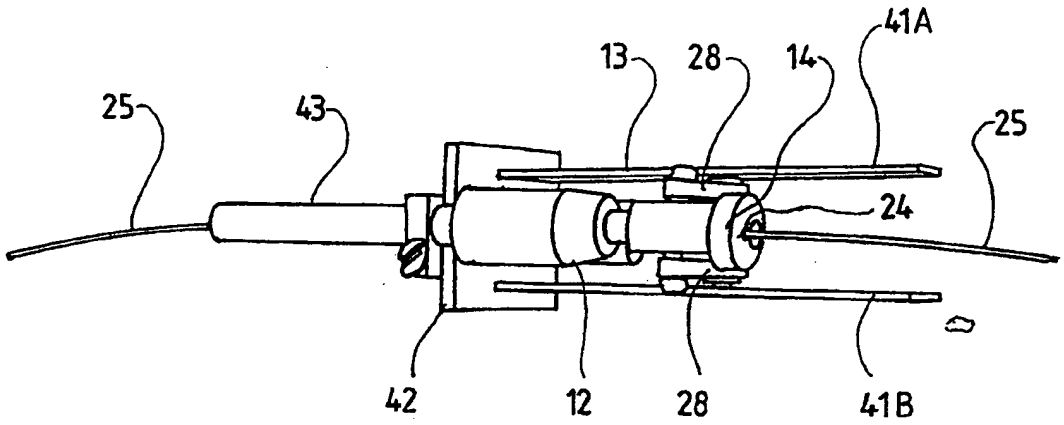

Fig. 5

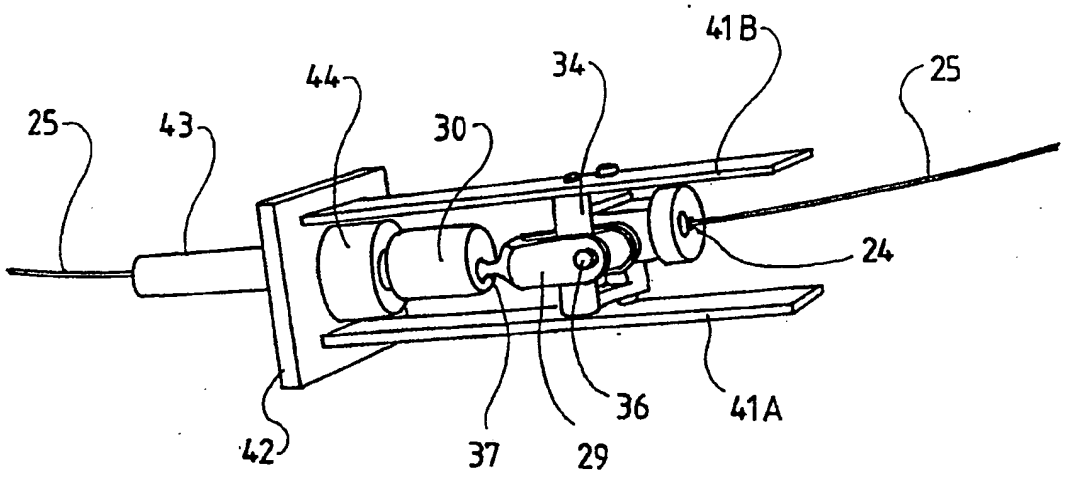

Fig. 6

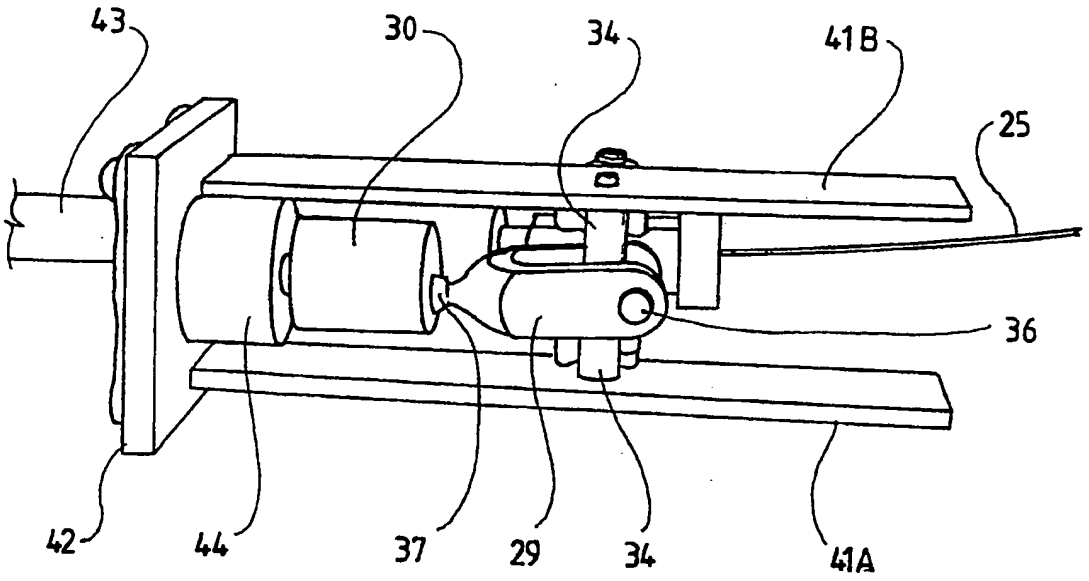

Fig. 7

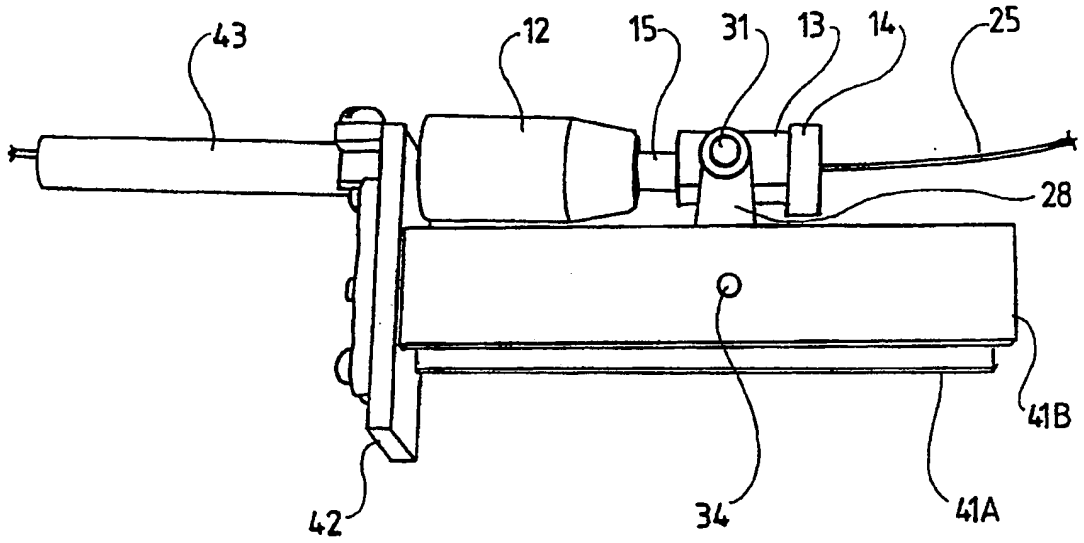

Fig. 8

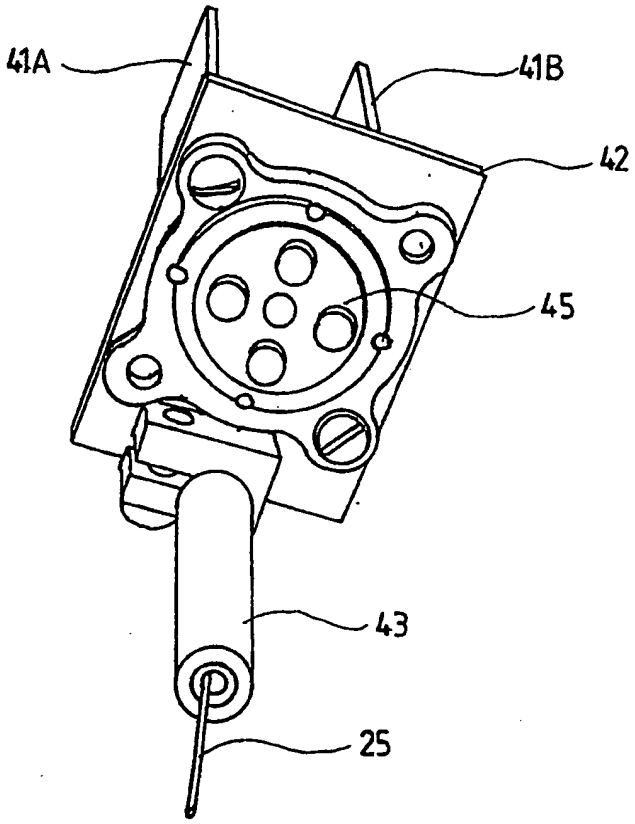

Fig. 9

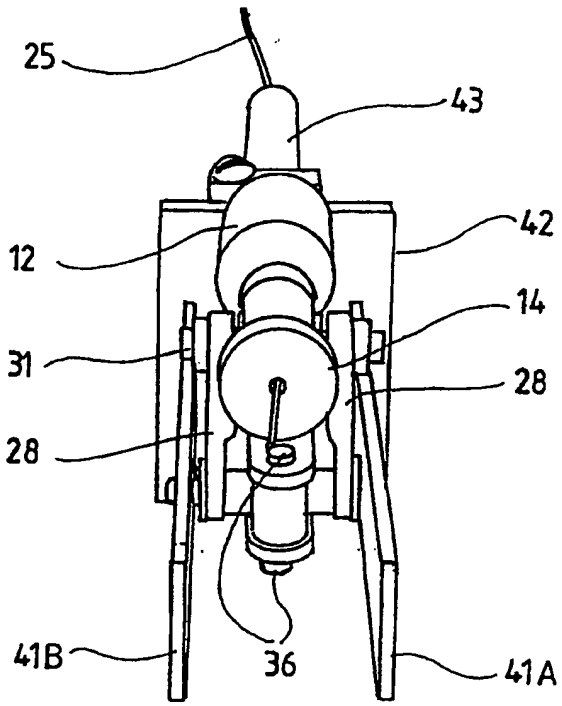

Fig. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU01/00246

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: B23K 9/12, B23K 9/133

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B23K 9/12, B23K 9/133, B23K 3/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DWPI, DELPHION (US patents): Int. Cl. as above and/or keywords (wire; feed; spring, bias; angle, inclined, tilted; diameter)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Derwent Abstract Accession No. 2000-409486/35, Class M23, RU 2136463 C1 (YURGINSK MECH ENG WKS STOCK CO) 10 September 1999 Abstract	12
A	US 5788139 A (SIKORA) 4 August 1998 Figure 10 , col. 5 lines 50-56, col. 9 lines 20-23	1
A	Derwent Abstract Accession No. 90-381773/51, Class P55, SU 1542733 A (PATON ELECTROWELD IND) 15 February 1990 Abstract	1

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

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Date of the actual completion of the international search	Date of mailing of the international search report
25 May 2001	5 June 2001
Name and mailing address of the ISA/AU	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU01/00246

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Derwent Abstract Accession No. 90-020520/03, Class P55, SU 1346370 A (LEPEKHIN YU P) 23 October 1987) Abstract	1

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU01/00246

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	5788139	DE	19714482	GB	2311954	GB	2340429
SU	1542733	NONE					
SU	1346370	NONE					
RU	2136463	NONE					

END OF ANNEX